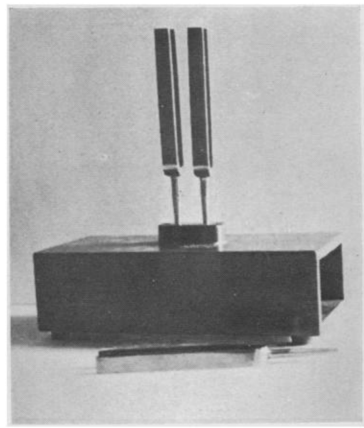
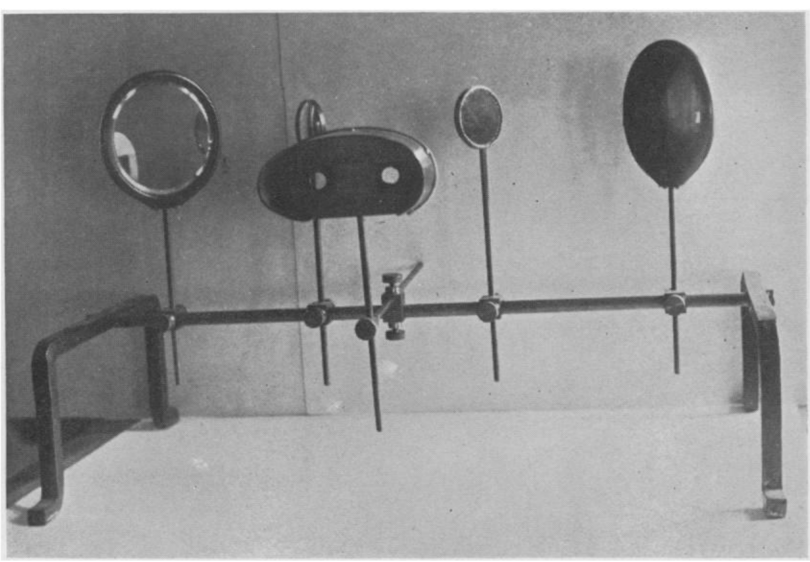
SOME NEW APPARATUS

I. An Observation Table

By Madison Bentley

The table is designed for the experimental observation of protozoa and other small animal forms, *e. g.*, the smaller insects, crustaceans and worms. The top of the table is made of ⅜ in. sheet brass, 15 x 20 cm. The legs are ½ in. brass posts, furnished at the bottom with levelling screws. An opening in the top receives an ordinary microscopic slide which lies flush with the surface. The slide is illuminated from below by means of a mirror, 5 x 10 cm., supported upon a horizontal axis which pierces the posterior legs. The table is placed with its back toward a window or near an electric lamp, and the mirror is rotated by a milled head at the right until the observation-slide falls within the path of the reflected rays. The opening below the slide is beveled toward the mirror to avoid a shadow. The whole of the upper surface of the slide, then, save a supporting strip upon three sides, is illuminated by strong transmitted light. A magnifying glass, 4 x 9 cm., swings in from the left when the slide is in place. The magnifying glass is focused by means of an adjustable collar rotating upon the table, and is fixed in position by two set-screws, the one at the left end of the table and the other in the horizontal support of the glass. The slide and the observer's eyes are protected from the direct rays of light by a thin sheet-brass screen, which rises 20 cm. from the convex posterior edge of the table-top and is continued half way across the ends. The observer looks through the enlarging lens straight down upon the slide, thus avoiding the direct rays of the mirror. A black background to the field of observation is secured by a thin shield which swings eccentrically between the anterior legs of the table, just clearing the mirror. When the shield is raised at the rear, its upper surface lies in shadow, and against this shaded surface the objects under examination stand out in relief. The entire apparatus is finished in dull black.

The writer has made use of Professor Jennings' slide-cell (cover-glass or second slide supported upon capillary tubing or glass strips) for protozoan responses to chemicals, carbon dioxide, temperature, etc. He has also used a slide tank (strips of glass cemented around the edge of the slide), wax-

pits (moulded upon the slide and connected subterraneously by capillary tubing), the capillary-tank (designed for the prolonged observation of a single individual), and various simple forms of the maze or labyrinth which are fashioned out of hot capillary tubes and secured to the slide by means of glass cement. The removal of a second section of the table-top permits the insertion of a square glass floor of ampler dimensions than the standard slide affords, for the intimate study of forms of considerable size.

In the construction of the Observation Table, the writer has had in mind the needs of junior students who lack the resources and the technique of the investigator; more specifically he has tried to bring within the limits of a training course, for the study of the simpler and lower forms, experimental conditions that are already realized in the current psychology of the higher animals.

II. A Demonstrational Stereoscope

By E. B. Titchener

The instrument shown at the bottom of the accompanying Plate is a combination of Wheatstone stereoscope, Helmholtz telestereoscope, and Mach pseudoscope. Its only novel feature is its extreme simplicity.

The materials, besides rods and clamps, are two hand-mirrors, two pocket-mirrors, and an ordinary stereoscope-hood from which the lenticular prisms have been removed. If we use the faces of all four mirrors, we have a telestereoscope. If we use the faces of the smaller mirrors, and affix stereoscope diagrams to the backs of the larger mirrors, we have the Wheatstone stereoscope. Finally, if the one eye is allowed to look directly at an object, while the other eye views the same object twice reflected (one large and one small mirror), we have the mirror pseudoscope. The arrangement of parts will be readily understood from the figure.

III. Tuning-Forks for Tests of Pitch-Discrimination

By E. B. Titchener and G. M. Whipple

The arrangement of tuning-forks figured in the upper part of the accompanying Plate shows our solution of a troublesome little problem. We wished to devise a means of testing the discrimination of pitch, with especial reference to the experimental study of school-children; and the requirements were that the apparatus should be inexpensive, as compact and

portable as possible, reasonably accurate and reliable, and so designed as to demand relatively little technical skill on the part of the experimenter.

Experience led us to discard at the outset strings, reeds, bottles and other wind-instruments, and to turn to tuning-forks. For discrimination work with forks, the experimenter must be able to produce readily and accurately a constant stimulus, and any one of a series of 8 to 10 variable stimuli. Such a series may be obtained from a pair of forks, the one of which carries sliding weights, etc., or from a number of forks, each one of which gives a single tone of constant pitch.

Adjustable riders of the sort used by Luft were unsuited to our purpose. They are difficult of manipulation by the inexperienced experimenter; the vibration difference must, after every determination of the difference limen, be computed anew by the laborious (and often difficult and inaccurate) method of counting beats; and the timbre of the two forks is often so different as to afford a secondary criterion of judgment. Screw-tipped forks, of the type suggested by Meyer, present similar disadvantages and are, furthermore, too limited in their range of adjustment to be available for tests of discrimination with unpractised or unmusical observers.

The problem is therefore narrowed down to that of finding an inexpensive and reasonably accurate set of forks, and of devising simple means of manipulation.

Seashore advises the employment of a single standard and a set of 10 variable forks, yielding stimulus differences of 0.5, 1, 2, 3, 5, 8, 12, 17, 23 and 30 vs. respectively[1]. Eleven forks of the standard laboratory type, mounted on resonance boxes, would be too expensive and too bulky to meet our requirements. The forks might be left unmounted, and be held after striking upon a single resonance box; but this method fails to guarantee even an approximate constancy of intensity. We have therefore made up a single resonator, upon which any pair of forks may be mounted together, and we have selected for the forks themselves the *a*-forks of 435 vs. sold by music houses at 50 cents apiece as 'extra heavy' forks for piano-tuners. The tines measure about 4.5 by 10 mm. in cross section and are about 95 mm. in length.

The ten variable forks are flatted as required by filing at the base of the U. The ball-tip with which they are supplied is filed away, and the stem is brought in the lathe to a tapered tip. The upper surface of the resonance box carries, as fork pedestal, an oval block of oak 45 mm. long, 20 mm. wide and 12 mm. thick, into which are sunk two conical holes, 20 mm.

[1]For most test work, the 0.5 stimulus-difference may be omitted.

apart and 10 mm. deep, for the reception of the stems of the two forks. The block is separated from the box by a single layer of chamois skin, and is secured to it by two light brass screws.[1]

The method of use is evident from these details of construction. The standard fork is set in the one hole, the variable in the other, with the axes of both crosswise to the box. The silent fork is damped by the finger while its mate is sounding, the finger is then transferred to the sounding fork, and the other is struck. Other variable forks are inserted as required. It is plain that any form of method may be employed. The tones themselves are rather surprisingly full and clear.

For transportation, the forks are wrapped in chamois skin and slipped into the resonance box.

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[1]The purpose of the chamois-skin layer is to eliminate the high partials which otherwise obscure the fundamental of a light fork when it is first struck. The screws are necessary, since, if glue is employed, the leather loses its elasticity. The dimensions of the block are reduced to a minimum in order to avoid overloading the box. The holes are made as shallow as is compatible with a firm support of the forks, since a deeply drilled hole in a tall pedestal seriously impairs the tone of these forks.